Oct. 28, 1969 C. D. CUPP 3,474,782

MEANS FOR DISPERSING GASES EXHALED FROM UNDERWATER BREATHING APPARATUS

Filed March 22, 1966 2 Sheets-Sheet 1

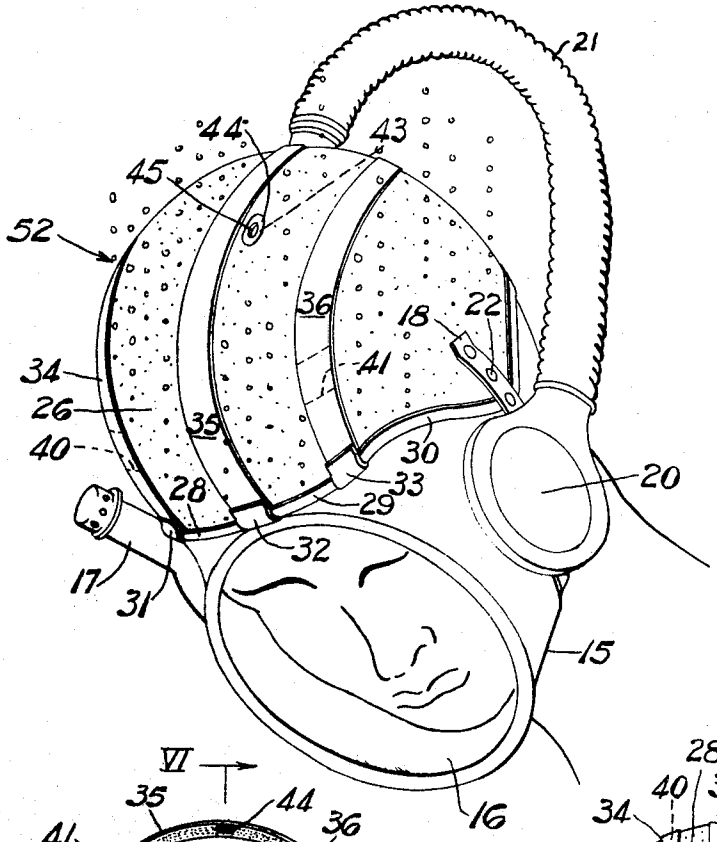

FIG. 1.

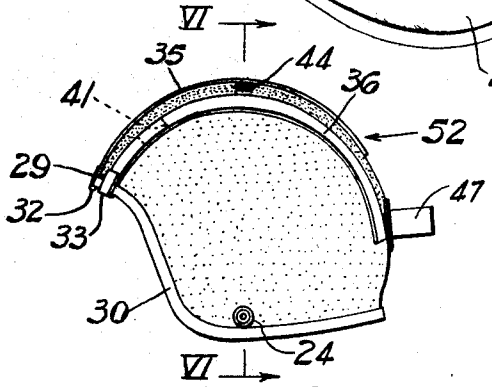

FIG. 2.

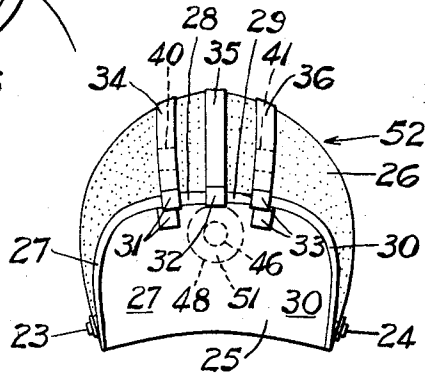

FIG. 3.

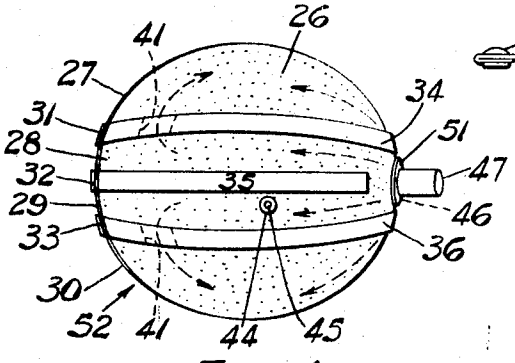

FIG. 4.

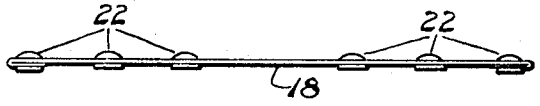

FIG. 5.

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MEANS FOR DISPERSING GASES EXHALED FROM UNDERWATER BREATHING APPARATUS

Filed March 22, 1966 2 Sheets-Sheet 2

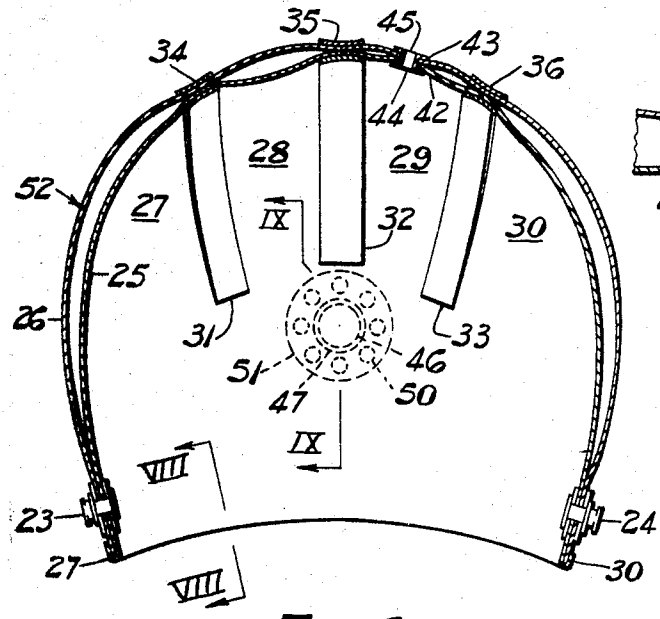

FIG. 6.

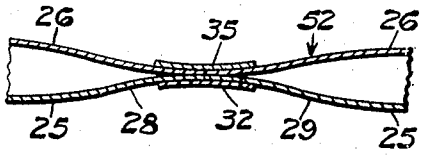

FIG. 7

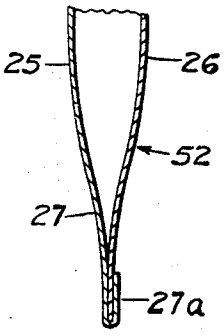

FIG. 8.

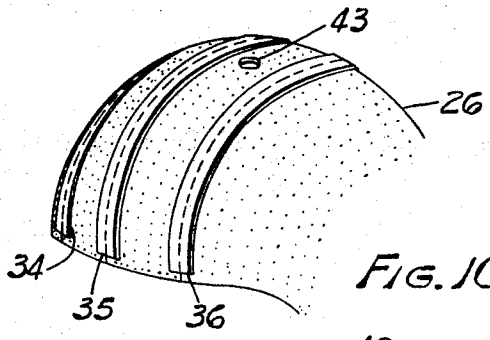

FIG. 10.

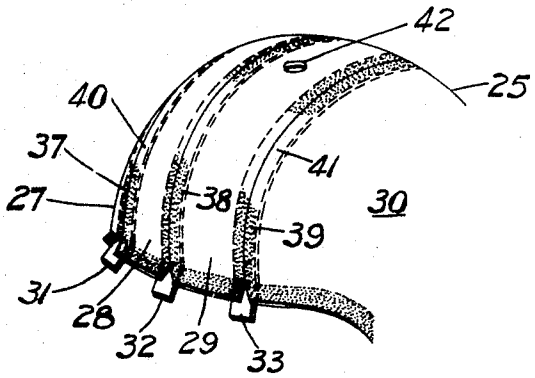

FIG. 11.

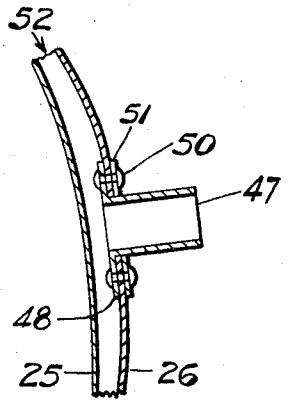

FIG. 9.

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3,474,782

MEANS FOR DISPERSING GASES EXHALED FROM UNDERWATER BREATHING APPARATUS

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Filed Mar. 22, 1966, Ser. No. 536,390
Int. Cl. A62b 7/02, 23/06; F01n 7/12
U.S. Cl. 128—142 8 Claims

ABSTRACT OF THE DISCLOSURE

An exhalation dispersing apparatus for use in a water medium having a headpiece adapted to fit the human head and comprising coextensive, elastic inner and outer liners which are sealed together along their peripheral edges and also along longitudinal portions thereof to form a plurality of transversely spaced exhalation chambers which open into a common exhalation chamber at the rear of the headpiece. Cross flow passages are provided between adjacent chambers. An exhalation conduit is connected from a breathing apparatus to the common chamber and a multiplicity of self-sealing apertures are provided in the outer liner for dispersing the exhaled air in the form of minute bubbles into the ambient water while precluding the ingress of water into the exhalation chambers. A vent is provided in the headpiece for releasing any air which might be trapped between the inner liner and the head of the swimmer.

This invention relates to gas dispersal apparatus and in particular to apparatus for dispersing exhaled gas from breathing apparatus carried by an underwater swimmer.

Heretofore, it has been difficult to conceal the presence of an underwater swimmer or frogman using breathing apparatus of the open type, wherein the swimmer's exhalation is discharged into the surrounding water, because the exhalation creates large bubbles of exhaled gas which rise to the surface and visually indicate the presence of the underwater swimmer. Also, the formation of such large bubbles around the face mask and breathing apparatus, their subsequent detachment and appearance on the surface of the water create an unacceptable noise level, well above the background noise level of the ambient water medium. Such noise may be sufficient to detonate nearby acoustical mines. Moreover, the noise created by the exhaust gas interferes with underwater communications. Prior attempts to remedy these problems have resulted in apparatus which are bulky, reduce the swimmer's speed and time underwater and which, in general, hamper the swimmer's freedom of movement.

Accordingly, it is an object of the present invention to provide an exhalation dispersing apparatus for an underwater swimmer adapted to materially reduce the visual and acoustical level of exhaled gas without hampering or encumbering the swimmer. It is known that there is an optimal location for breathing components working against ambient pressure. This location can be defined as a balanced breathing zone or area positioned in vertical alinement with the nose at about the level of the larynx or suprasternal notch. While location of such components at elevations other than this zone may not be noticed when standing in air, it is more significant underwater where relatively small variations in depth are accompanied by relatively large variations in pressure. A swimmer attempting to exhale against ambient water pressure at a depth greater than that of his balanced breathing zone must develop an extra amount of positive pressure in his lungs just to exhale. This is undesirable.

Therefore, another object of my invention is to provide

an exhalation dispersing apparatus for underwater use providing an exhaust route into the ambient water at an elevation above the balanced breathing zone at all position normally assumed by an underwater swimmer.

The dispersion apparatus of my invention takes the form of a headpiece shaped to fit the human head and incorporating a chamber arranged to receive the exhalation, the chamber having a multiplicity of minute apertures for dispersing the exhaust gas into the ambient water.

Various other novel features of construction and advantages inherent in the exhalation dispersing apparatus of the present invention are pointed out in detail in conjunction with the following description and accompanying drawing of a typical embodiment of the invention. It is to be understood that such embodiment is by way of example only and to illustrate the principles of the present invention, the scope of which is limited only as defined in the appended claims.

In the drawings, wherein like reference numerals denote like parts throughout the various views:

FIG. 1 is a perspective view illustrating a dispersion helmet of my invention in combination with a full face scuba mask and exhalation hose, as the same appear in use;

FIG. 2 is a side elevation, on a reduced scale, of the helmet detached from the mask and exhalation hose;

FIG. 3 is a front elevational view thereof;

FIG. 4 is a top plan view thereof;

FIG. 5 is a front elevational view of a detached chin strap for use with the helmet of the present invention;

FIG. 6 is a transverse section on an enlarged scale, taken about on the line VI—VI of FIG. 2;

FIG. 7 is an enlarged, fragmentary, transverse section through an upper portion of the helmet showing the inner and outer liners of the helmet joined together at a seam;

FIG. 8 is an enlarged, fragmentary section through the lower edge of the helmet, taken about on line VIII—VIII of FIG. 6 and showing the seal at the periphery of the inner and outer liners;

FIG. 9 is a fragmentary, vertical section taken about on line IX—IX of FIG. 6 showing the gas inlet;

FIG. 10 is a fragmentary perspective view of the outer liner of the helmet prior to securement to the inner liner; and

FIG. 11 is a corresponding fragmentary perspective view of the inner liner of the helmet prior to securement to the outer liner.

Referring now in detail to the drawing, there is shown in FIG. 1 a typical full-face scuba face mask **15** having a transparent front lens, a snorkel tube **17**, a chin strap **18**, an exhalation outlet fitting **20** and an exhalation conduit or hose **21**. Chin strap **18** is constructed of elastic material and provided with six snap buttons **22**, any pair of which is adapted to engaged with a pair of snap fasteners **23, 24** secured to the lower lateral edges of the dispersion headpiece or helmet **52**.

Headpiece **52** is shaped to substantially conform to and fit over the head of the user thereof. When in place, the peripheral edge of headpiece **52** extends from a position immediately above the eyes of the user and above mask **15** to side positions below the ears and around the back lower portion of the user's head adjacent the back of the neck. Thus, headpiece **52** substantially encloses the entire head including the forehead, the top and back of the head and both sides thereof including the ears but excluding the front facial features. In this respect, it is similar to conventional underwater headpieces.

Headpiece **52** consists essentially of an inner head liner **25** and an outer dispersion liner **26** substantially coextensive therewith. Inner liner **25** is made of a rubbberized, impermeable, two way stretch fabric and can comprise a

single piece of fabric cut lengthwise along an intermediate and front portion thereof forming four flaps **27**, **28**, **29** and **30**. The fabric is slit to the extent necessary to shape the flaps to the contours of a head and is not slit at the opposite rear portion thereof. The four flaps are placed in juxtaposition and sealed together adjacent their juxtaposed inner edges forming seams extending from the front periphery over the top of the helmet and terminating in an uncut integral rear portion adjacent the back lower portion of the headpiece (FIG. 6). The peripheral edges of the four flaps terminate in discrete foldable edges indicated by the shaded peripheral portions of FIG. 11. Tapes **31**, **32** and **33** are cemented along the seams on the interior of the headpiece and extend from the front periphery rearwardly along respective seams, terminating beyond the terminal portions of the seams at the uncut fabric. The front terminal portions of tapes **31** ,**32**, and **33** extend beyond the periphery of the headpiece (FIG. 11) for securement thereof to similar tapes secured to the outer liner.

Outer dispersion liner **26** also is made of an elastic, rubberized two-way stretch fabric, similar to the fabric used on inner liner **25**, and like liner **25**, can comprise a single piece of fabric cut lengthwise along an intermediate and front portion thereof forming four flaps as seen in FIG. 10. The flaps are sealed adjacent their juxtaposed edges forming seams extending from the periphery over the top of the headpiece terminating in an uncut integral rear portion adjacent the back lower portion of the headpiece. Outer dispersion line is therefore formed in a manner identical to the inner head liner except that the outer liner is somewhat larger than the inner liner so that it may fit over the inner liner and form a chamber therebetween. Tapes **34**, **35** and **36** are bonded to liner **26** over the seams of the outer liner and are coextensive therewith.

The peripheral portions of outer line **26** are secured, by cement, to inner liner **25** adjacent the peripheral portions thereof. The outer edges of inner line **25** are turned up, folded back and cemented along the outer peripheral portion of outer line **26** in sealing engagement therewith as indicated at **27***a* in FIG. 8. Furthermore, the terminal ends of tapes **31**, **32** and **33** are cemented on their outer faces and turned upwardly to overlie respective terminal portions of tapes **34**, **35** and **36** and are sealed thereto. In addition, inner and outer liners **25**, **26** are cemented together along their longitudinal seam lines as indicated by the shading of FIG. 11, the cement being applied to the underside of the seam lines of outer liner **26** and to the outside of the seam lines of inner liner **25** thereby forming four transversely spaced longitudinal chambers extending from the peripheral forehead portion of the headpiece back to the terminal portions of the seams and tapes opening into a common chamber adjacent the uncut portions of the fabric of both liners. However, the portions of the seam lines indicated at **40** and **41** are not cemented together.

It is desirable that any air between the inner liner **25** and the head of the swimmer be released immediately upon donning the headpiece. Suitable matching holes **42** and **43** are thereofore provided in the upper central portions of the inner and outer liners. A grommet **44** passes through holes **42** and **43**, sealing both the inner and outer liners therearound and forming a reinforced vent **45** for releasing air which otherwise would be trapped between inner liner **25** and the head of the swimmer.

A hole **46** is formed at the rear central portion of outer liner **26** and receives a rust-proof fitting in the form of an outwardly extending, stainless steel ferrule **47** having a flange **48** thereon (FIG. 9). Ferrule **47** is adapted to receive one end of exhalation tube **21**. Circumferentially spaced rivets **50** clamp outer liner **26** between a washer **51** and flange **48**, thereby sealing ferrule **47** to outer liner **26**.

The construction of outer liner **26** forms, in combination with the inner liner, a vital aspect of my invention. The outer liner is constructed to enable the escape of exhaled air from the chambers through the outer liner during the exhalation portion of the breathing cycle of a swimmer, while precluding the ingress of water into the chambers. Further, the escaping gas is broken up into minute bubbles, difficult to detect. To this end, a plurality of closely spaced, minute apertures are formed through outer liner **26**. The apertures have, in the preferred form, a density approximating twenty apertures per square inch of outer liner surface, are spaced therealong over the entire outer liner surface, excluding only the taped portions of the headpiece.

The apertures may be formed, in the preferred embodiment, by puncturing outer liner **26** at closely spaced intervals completely thereacross. A simple puncture in the rubberized fabric of lining **26** does not remove the liner material, but forms a minute aperture which tends to close and become self-sealing. This seal-sealing feature is particularly important, since it prevents the ingress of water to the chambers during the inhalation portion of the breathing cycle.

The apertures also can take the form of very small diameter openings, sufficiently small so that water entry, during the inhalation portion of the breathing cycle, is precluded due to the formation of a surface tension film over each opening.

The chambers formed between the inner and outer liner flaps are necessary and desirable if proper and efficient dispersion of the exhaled gas is to be obtained. However, the inner surfaces of both liners sometimes tend to stick together at various points in the dispersing chambers, in a manner impeding regular flow of exhaled gas into the chambers and out through the apertures. To compensate for this, areas **40** and **41** are left uncemented and provide cross flow communication passages between adjacent chambers. Consequently, any temporary closing of one of the chambers by the sticking together of liners **25** and **26** at the rear of the headpiece, near the entrance to the chamber, is by-passed by respective cross flow passages **40** and **41** thereby providing regular, unimpeded gas communication with all of the chambers. The inlet ferrule **47** is positioned closely adjacent the chamber inlets but spaced from the cemented seams.

In use, the exhaled gas from mask **15** passes through exhalation hose **21** and ferrule **47**, into the dispersion chambers defined between the inner and outer liners and escapes through the apertures or openings in the outer liner into the surrounding water. The exhaled gas, being dispersed through a multiplicity of minute apertures or openings, is divided into minute bubbles which escape from the headpiece into the surrounding water medium with a minimum of noise and which float to the surface of the water with minimum disturbance.

It will be noted that an escape route for exhaled gas is provided at the front, top, rear and opposite sides of the swimmer's head. As a result, there is provided an escape route at an elevation above the aforesaid balanced breathing zone in all normal positions of use. When upright, all parts of the apertured liner **26** are at or above this zone. When prone, swimming face down, the rear and adjacent side portions are above this zone. When prone on either side, the opposite side of the helmet is above the zone. Therefore, no excess exhalation effort normally will be required.

Having thus described and illustrated a preferred embodiment of my invention, it will be understood that such description and illustration is by way of example only and that such modifications and changes as may suggest themselves to those skilled in the art are intended to fall within the scope of the present invention which is limited only by the scope of the appended claims.

What I claim is:

1. Means for dispersing exhaled gas from a breathing apparatus adapted for use in a water medium comprising

a protective headpiece shaped to enclose and conform to the forehead, top back and opposite side portions of the human head, said headpiece comprising an inner head liner and an outer dispersion liner substantially coextensive therewith, said inner and outer liners being secured together adjacent the peripheral portions thereof and forming a chamber therebetween substantially coextensive therewith, said outer liner being elastic and having a multiplicity of closely spaced minute apertures passing therethrough over substantially the entire surface thereof providing communicating passages between said chamber and an ambient water medium, and means for communicating exhaust gas from a breathing apparatus to said chamber whereby such gas is exhausted through said apertures and dispensed into an ambient water medium in the form of a multiplicity of minute bubbles.

2. Dispersing means according to claim **1** wherein said apertures are small diameter openings closely spaced along substantially the entire surface of said headpiece.

3. Dispersing means according to claim **1**, wherein said apertures are self-sealing punctures closely spaced along substantially the entire surface of said headpiece.

4. Dispersing means according to claim **1** wherein said headpiece includes means interconnecting said inner and outer liners thereby forming a plurality of said chambers, said communicating means communicating with all of said chambers.

5. Dispersing means according to claim **1**, wherein said

headpiece includes passage means extending through said inner and outer liners for releasing air trapped between said inner liner and a head.

6. Dispersing means according to claim **1**, said liners being sealed together at their peripheral edges and along longitudinal portions thereof forming a plurality of transversely spaced chambers opening into a common chamber at the rear portion of said headpiece, and wherein said communicating means opens into said common chamber.

7. Dispersing means according to claim **6**, including passage means at the front portion of said headpiece providing communication between each of said transversely spaced chambers and at least one other thereof.

8. Dispersing means according to claim **6**, wherein said apertures are small diameter openings closely spaced along substantially the entire surface of said outer liner.

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WILLIAM E. KAMM, Primary Examiner

U.S. Cl. X.R.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,474,782 Dated October 28, 1969

Inventor(s) Charles D. Cupp

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, in the heading, the name of the assignee should be --"Automatic" Sprinkler Corporation of America--.

SIGNED AND
SEALED
FEB 17 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents